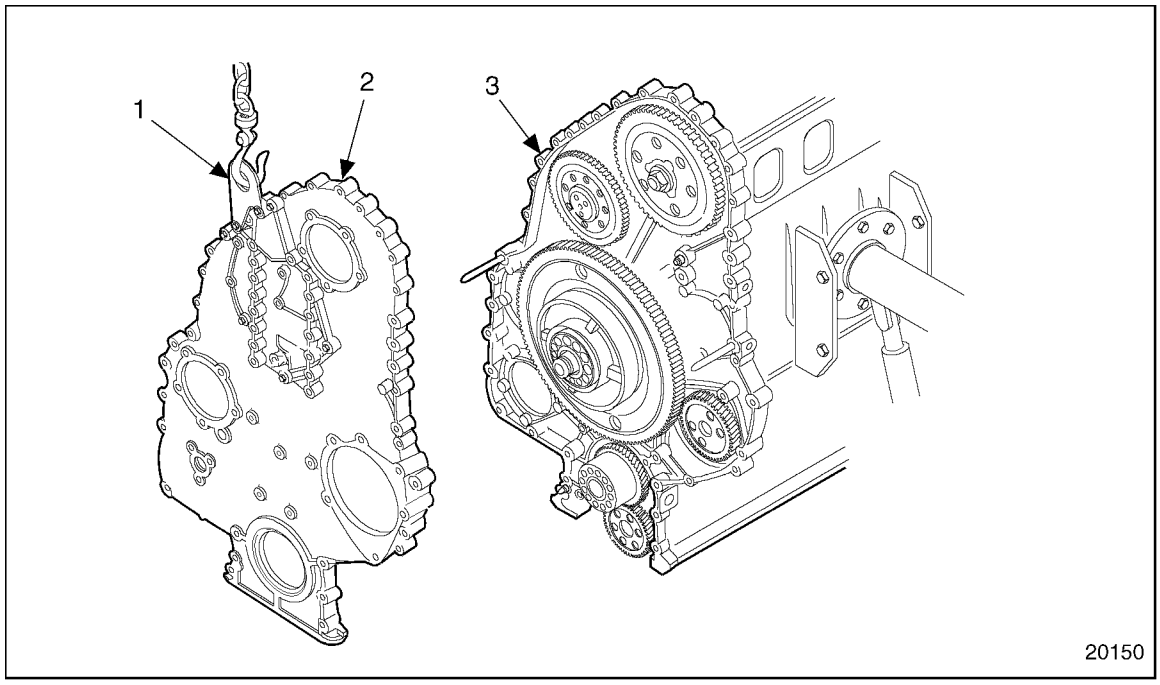
1.11 GEAR CASE

The gear case housing is constructed of cast iron, with machined mating surfaces, and is bolted to the front of the engine cylinder block. The gear case and gear case cover are bolted together to provide a sealed compartment for the engine gear train. See Figure 1-187.



1. Lifting Bracket
2. Gear Case Cover
3. Gear Case Housing

Figure 1-187 Gear Case and Gear Case Cover

Several components are mounted to the gear case, including the adjustable idler gear assembly, see Figure 1-190, the fuel pump drive assembly, see Figure 1-191, the air compressor drive assembly or raw water pump drive assembly, see Figure 1-192; the water pump assembly (1991 and later engines) see Figure 1-193; and the camshaft thrust plate and drive gear assembly see Figure 1-210.

In July 2001, new right and left side gear case stiffening brackets were added to provide: reduce engine noise, increase belt driven accessory life, reduce gear case vibration amplitude and reduce wear on the cam thrust plate perimeter seal. See Figure 1-188 and see Figure 1-189 .

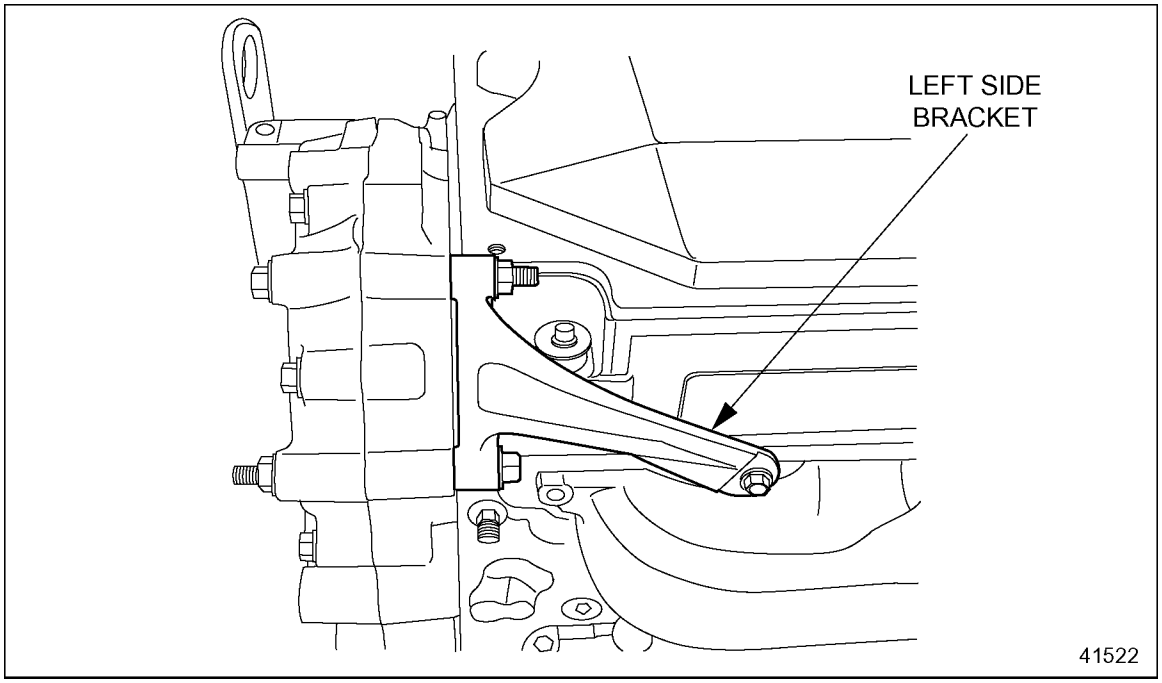


Figure 1-188 Gear Case Stiffening Bracket (Left Side)

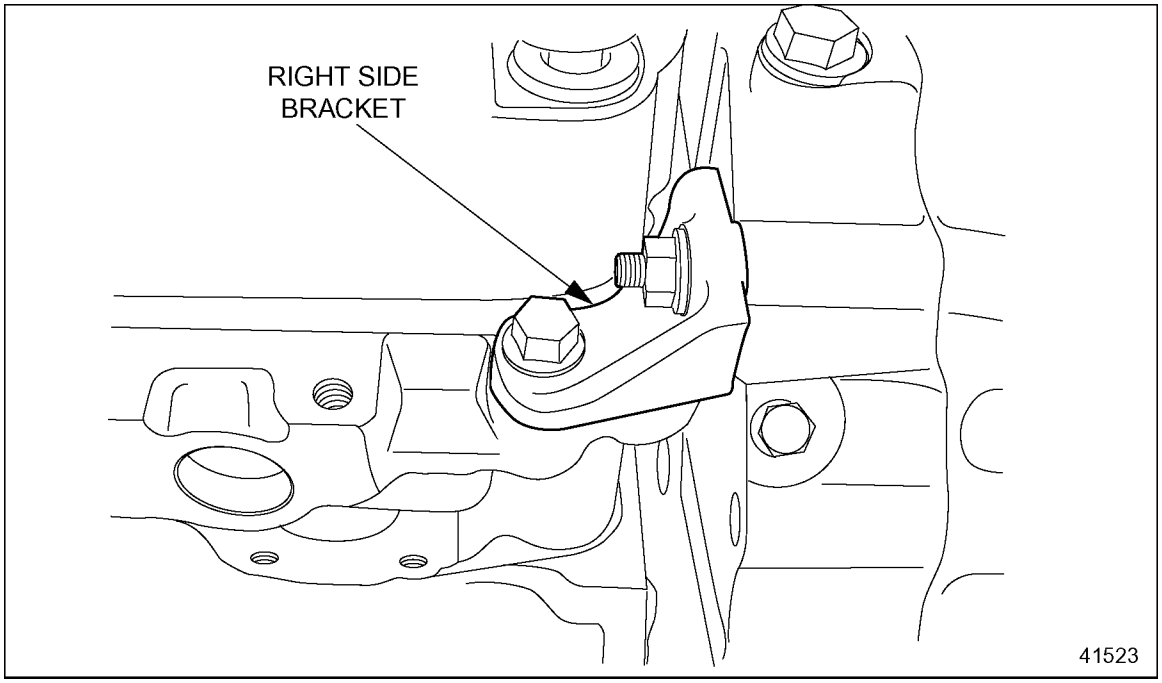


Figure 1-189 Gear Case Stiffening Bracket (Right Side)

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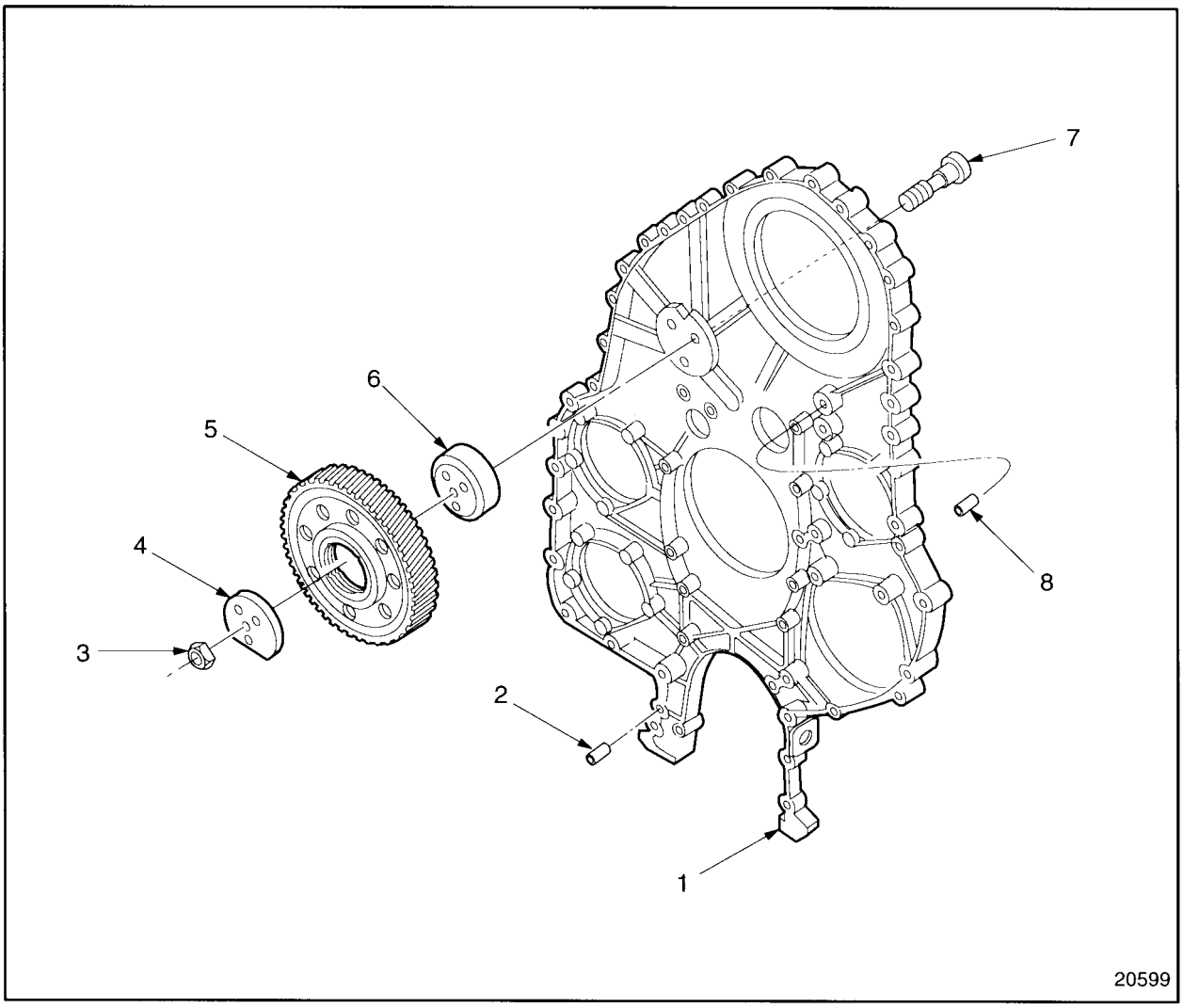
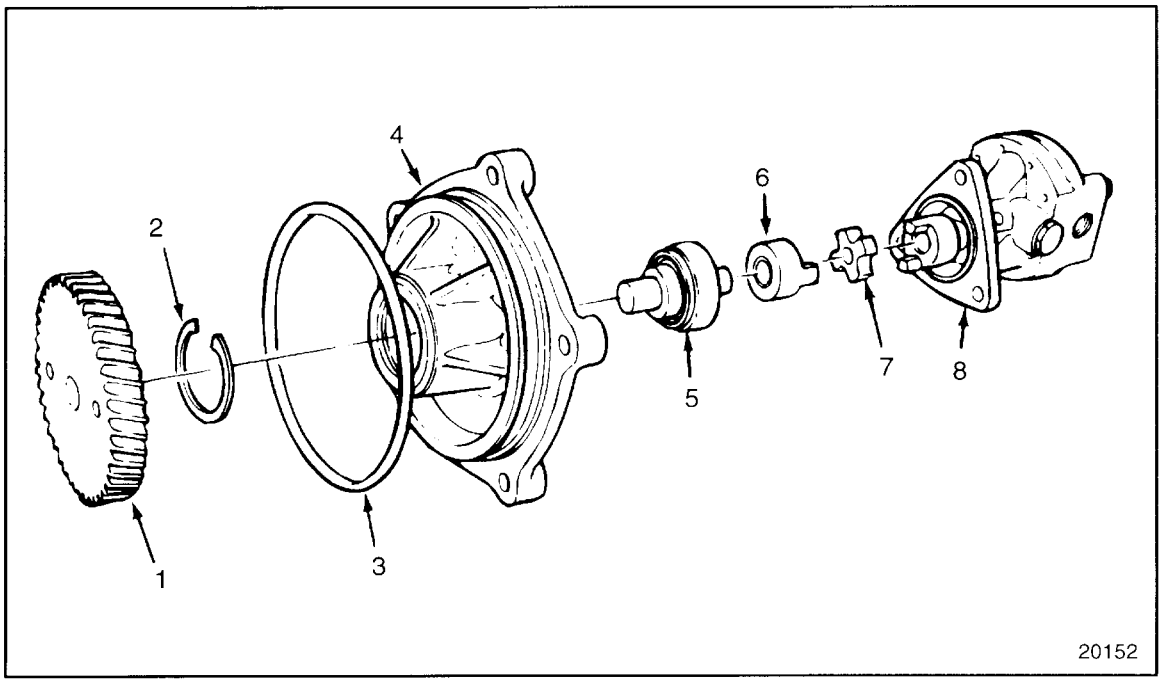


1. Gear Case
2. Diamond Dowel
3. Adjustable Idler Gear Locknut (3)
4. Adjustable Idler Gear Hub, Retainer
5. Adjustable Idler Gear
6. Adjustable Idler Hub
7. Adjustable Idler Gear Stud (3)
8. Round Dowel

Figure 1-190 Adjustable Idler Gear Assembly



1. Fuel Pump Drive Gear
2. Snap Ring
3. O-ring
4. Fuel Pump Drive Housing
5. Shaft and Bearing Assembly
6. Fuel Pump Drive Hub
7. Fuel Pump Drive Coupling
8. Fuel Pump Assembly

Figure 1-191 Fuel Pump Drive Assembly

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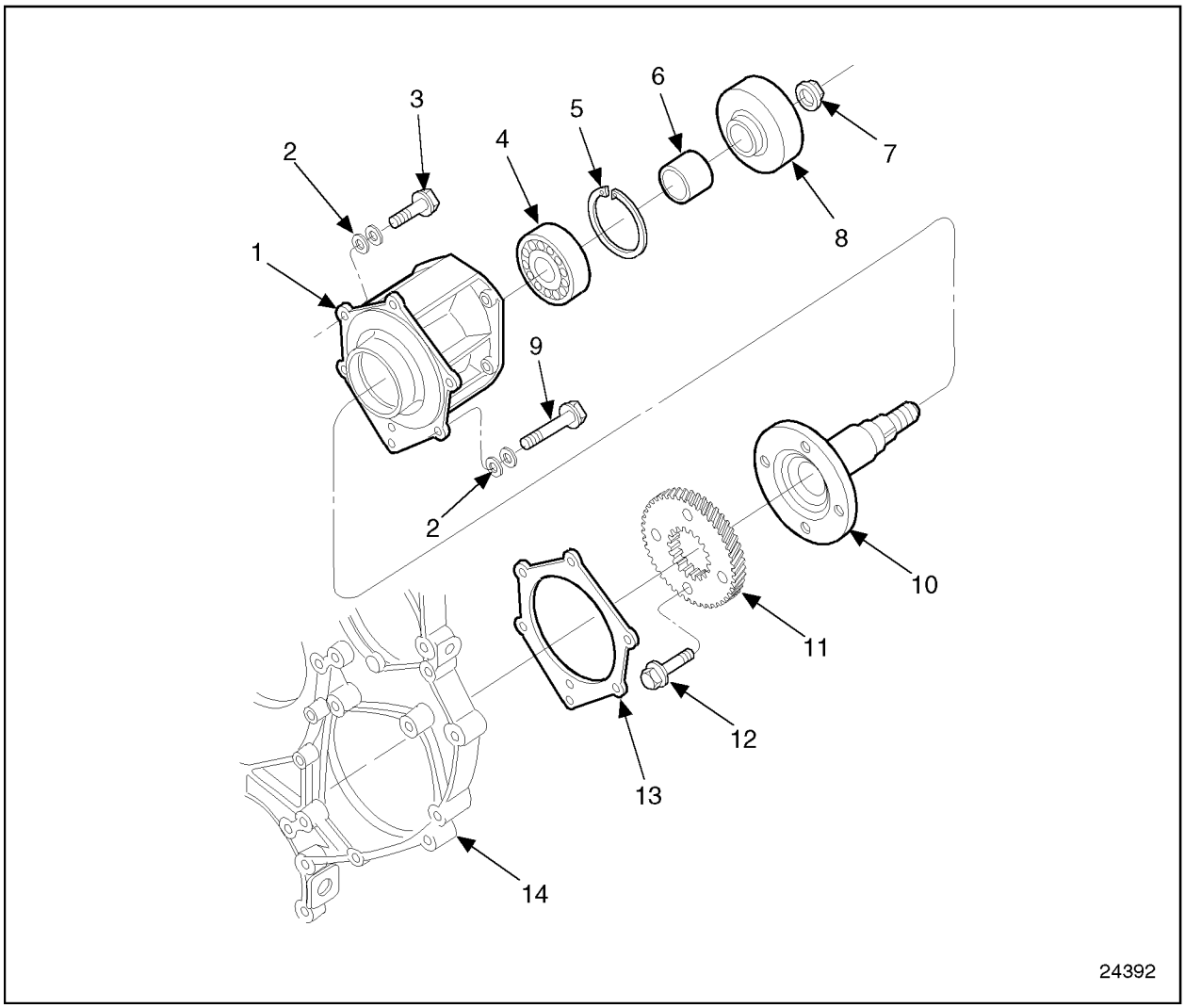
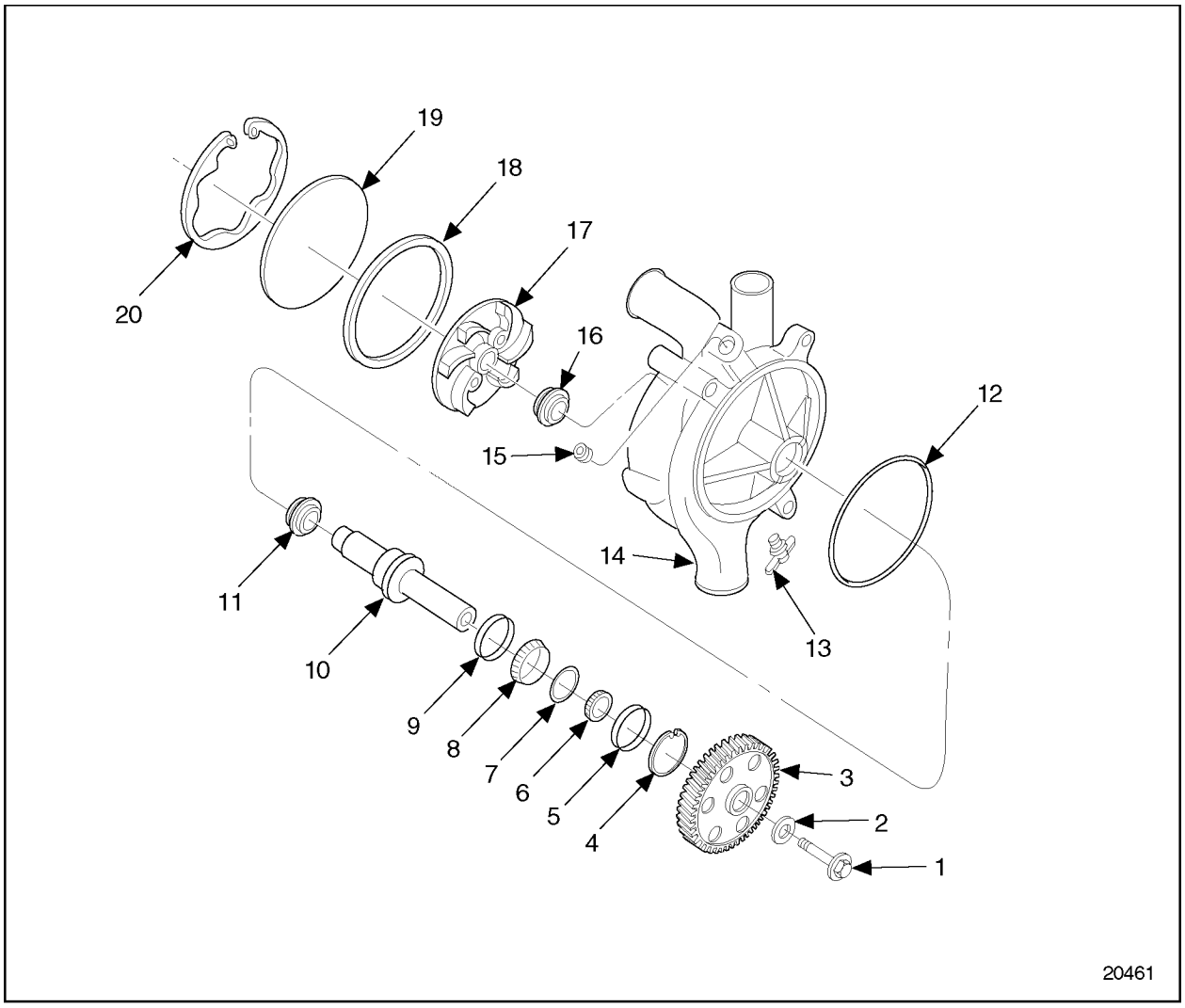


1. Drive Housing
2. Washers
3. Drive Housing Short Bolt
4. Drive Ball Bearing
5. Snap Ring
6. Spacer
7. Drive Hub
8. Drive Hub Flange Nut
9. Drive Housing Long Bolt
10. Drive Shaft
11. Drive Gear
12. Drive Gear Bolt
13. Drive Housing Gasket
14. Gear Case Housing

Figure 1-192 Air Compressor or Raw Water Pump Drive Assembly



1. Retaining Bolt
2. Washer
3. Water Pump Drive Gear
4. Snap-ring
5. Bearing Race
6. Bearing
7. Spacer Rings (2)
8. Bearing
9. Bearing Race
10. Drive Shaft
11. Oil Seal
12. Water Pump Housing O-ring
13. Drain Cock
14. Water Pump Housing
15. Water Pump Housing Pipe Plug
16. Water Seal
17. Impeller
18. Water Pump Cover O-ring
19. Water Pump Cover
20. Water Pump Cover Snap Ring

Figure 1-193 Water Pump Assembly

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To eliminate the possibility of oil leakage at the adjustable idler gear stud location, Detroit Diesel recommends the following:

When rebuilding a Series 60 engine, or if the gear case is removed for any reason, the three original adjustable idler gear studs should be removed and replaced with new studs.

Before pressing studs into the gear case, coat the shanks and underside of the stud heads with Loctite® No. 242 Sealant. This will prevent any oil leakage around the studs during engine operation.

The Timing Reference Sensor (TRS) is an electronic component that is bolted to the side of the gear case on the intake (left) side of the engine just above the oil pan. See Figure 1-194.

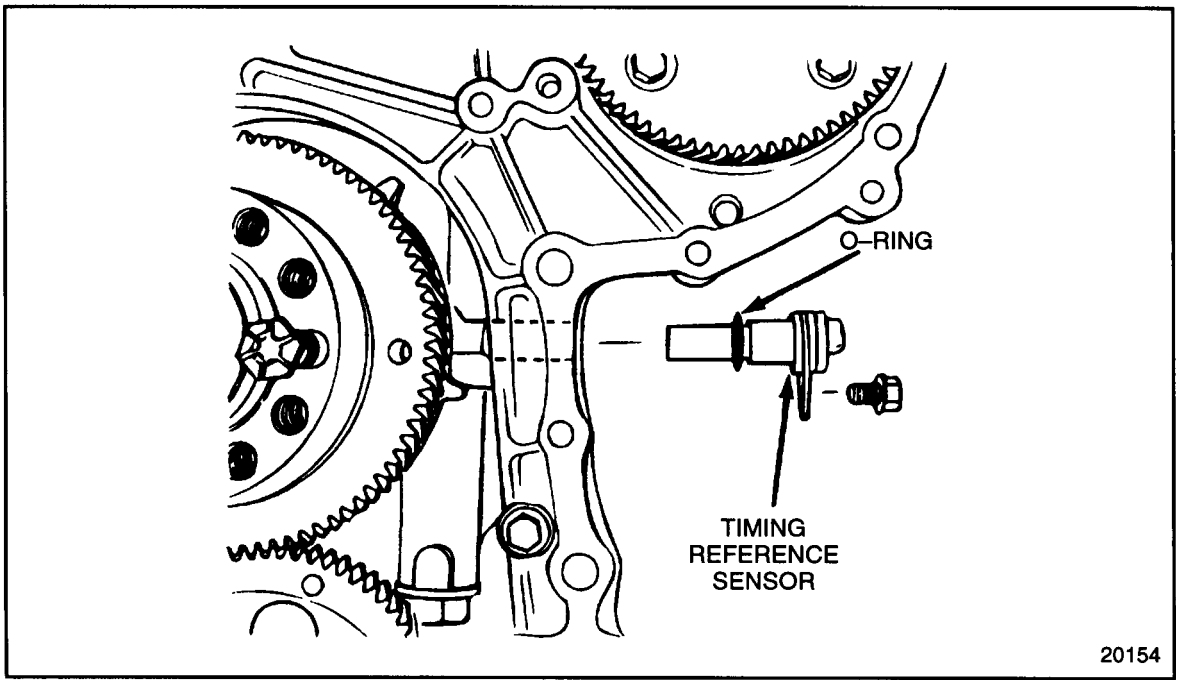

Figure 1-194 Timing Reference Sensor (TRS)

The Synchronous Reference Sensor (SRS) is an electronic component that is bolted to the gear case at the lower, intake (left) side of the engine. See Figure 1-195.

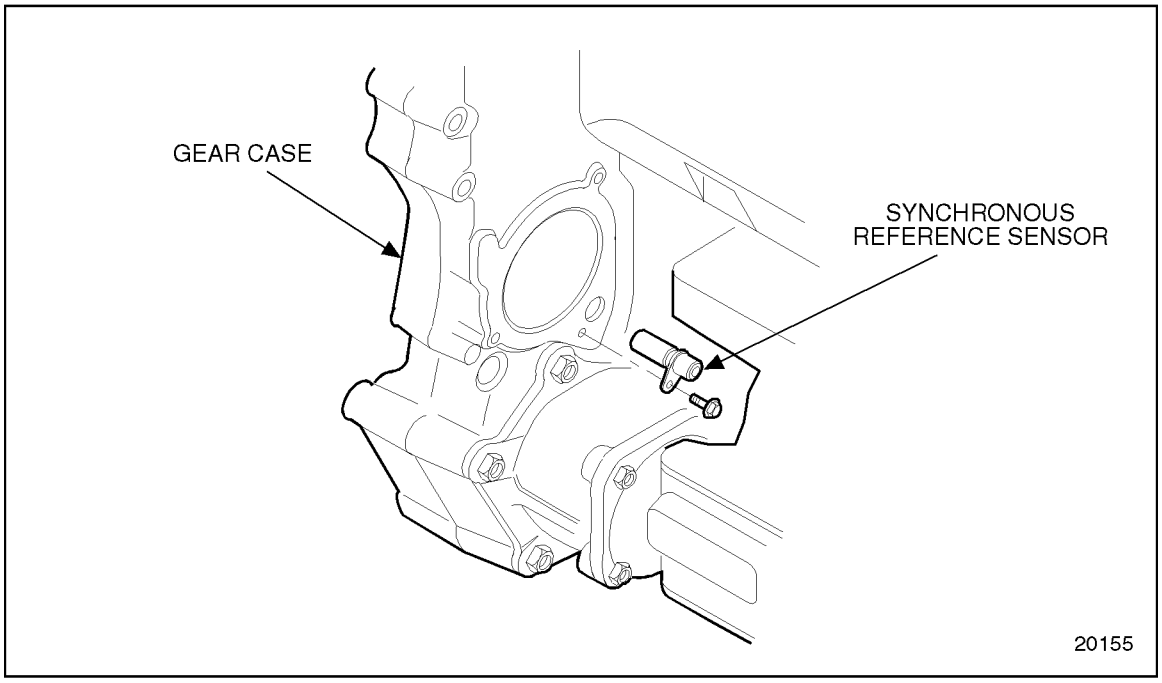

Figure 1-195 Synchronous Reference Sensor

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An opening is provided in the center of the gear case, for the bull gear and camshaft idler gear assembly, which bolts directly to the engine block. See Figure 1-196.

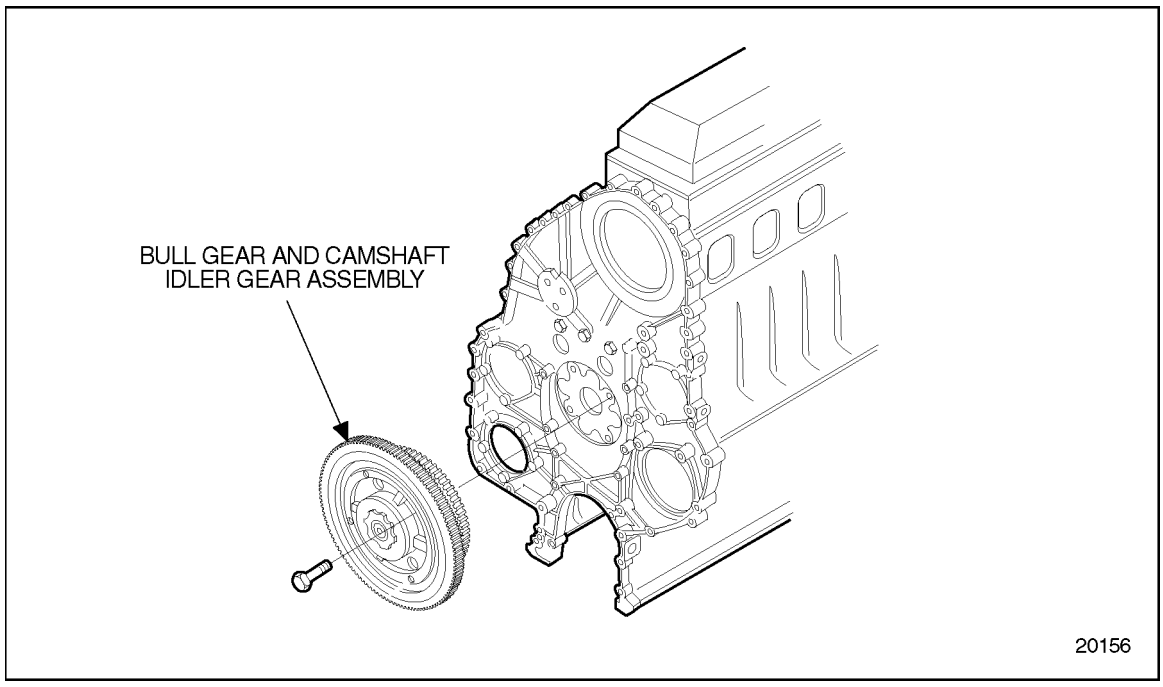

Figure 1-196 Bull Gear and Camshaft Idler Gear Assembly

An access cover is provided at the rear of the gear case on the cooler (right) side of the engine. This access cover provides an opening for inspection of the accessory drive assembly drive gear. See Figure 1-197.

NOTE:
This access cover opening may be cast closed on the rear of the gear case.

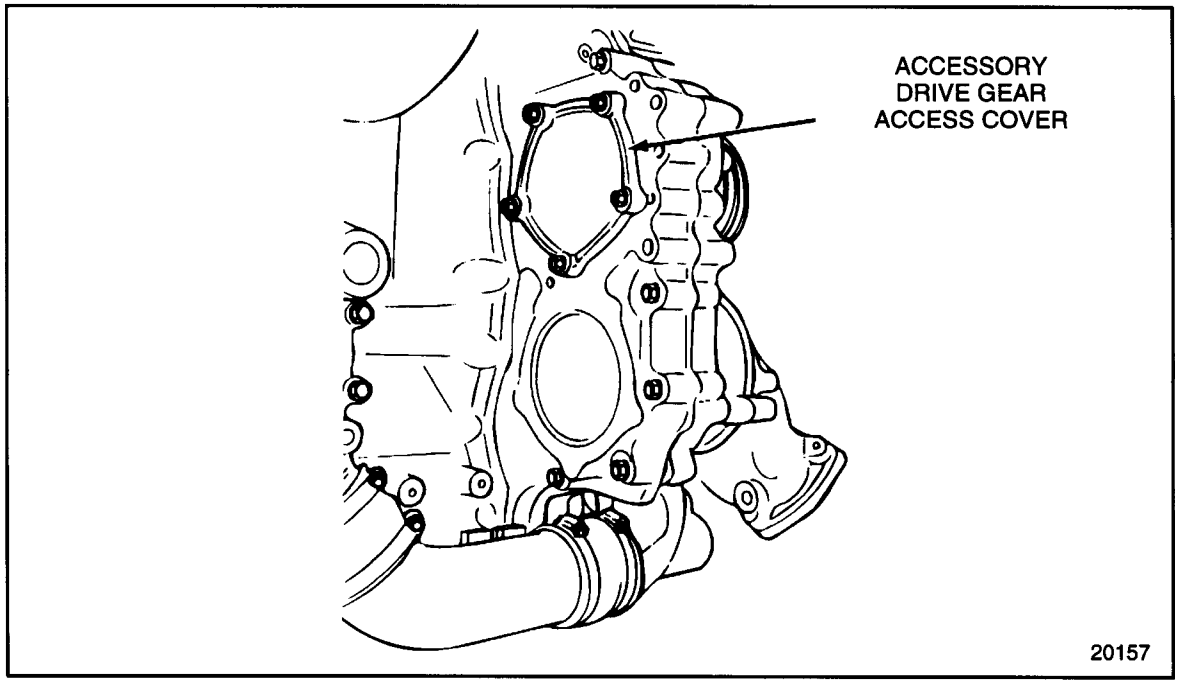

Figure 1-197 Accessory Drive Gear Access Cover (Pre-1991 Engines)

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For gear lash measurement and adjustment procedures for the gears in the engine gear train, Refer to section .

An oil gallery is drilled in the gear case casting, for lubrication of the adjustable idler gear assembly. A hole in the front of the cylinder block, indexes with the gear case gallery. At the edge of the gear case the gallery is threaded for insertion of a plug. An exit hole feeds the adjustable idler gear assembly. See Figure 1-198.

NOTE:
Do not use the oil plug location for an oil supply or for checking oil pressure.

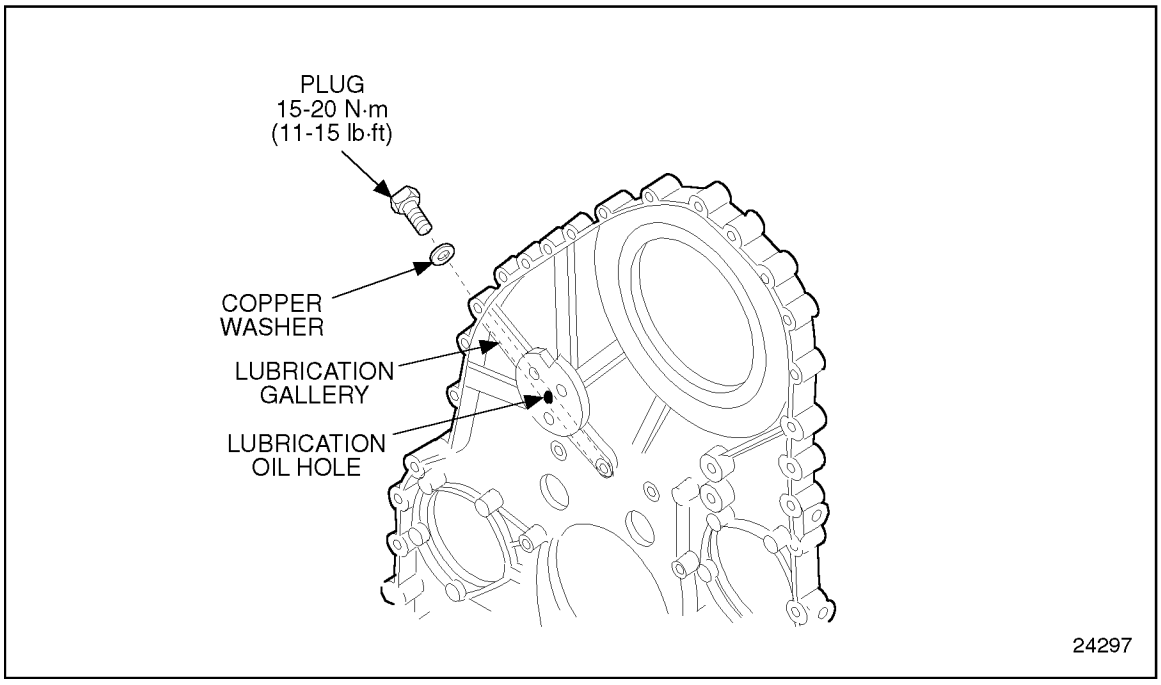

Figure 1-198 Adjustable Idler Gear Lubrication Gallery

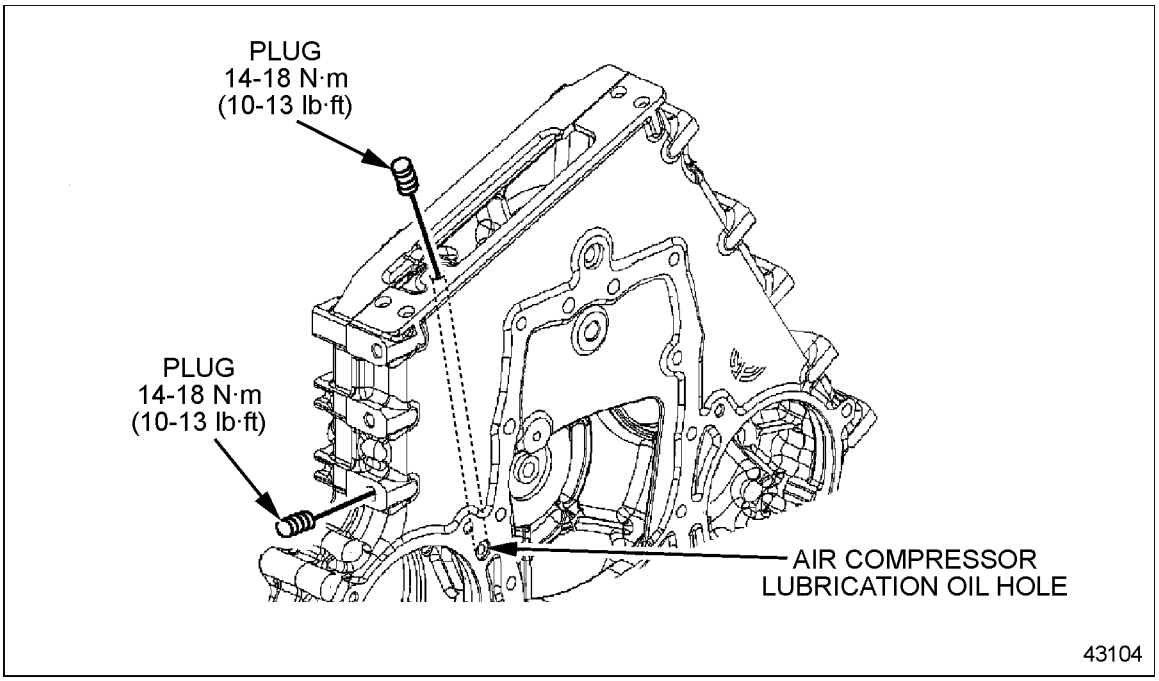

Figure 1-198a Air Compressor Lubrication Gallery

For the Series 60 2002 Engine there is a drilled oil passage in the gear case casting for lubrication of the air compressor. See Figure 1-198a.

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1.11.1 Repair or Replacement of Gear Case

To determine if repair is possible or replacement is necessary, perform the following procedure. See Figure 1-199.

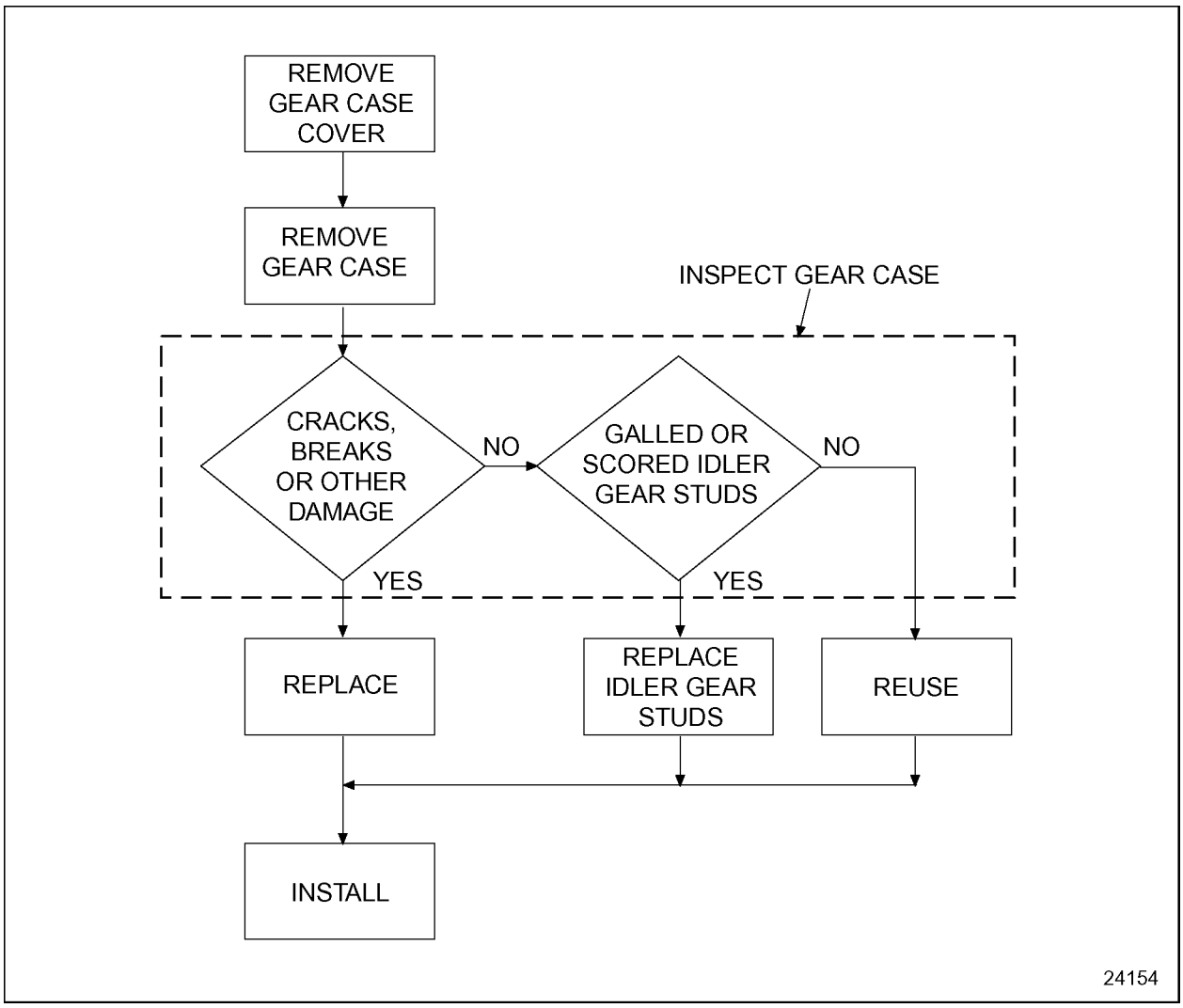

Figure 1-199 Flowchart for Repair or Replacement of Gear Case

1.11.2 Removal of Gear Case

Perform the following steps to remove the gear case:

1. Remove the SRS. Refer to section 2.29.2 .
2. Remove the TRS. Refer to section 2.30.2 .
3. Remove the rocker arm assemblies. Refer to section 1.3.2.
4. On heat exchanger-cooled marine engines, remove the water-cooled charge air cooler. Refer to section 4.4.2 . Or remove the heat exchanger tank. Refer to section 2.13.1 .
5. Perform all of the steps for camshaft removal. Refer to section 1.23.2.
6. For Series 60 2002 Engine remove compact gear train assembly. Refer to section 1.23.
7. Remove the 3 bolts that secure the camshaft gear pilot tool, J 35906, to the gear case and remove the tool.
8. Remove the three bolts securing the former right side gear case stiffening bracket, or two bolts securing the current right side gear case stiffening bracket. See Figure 1-200.

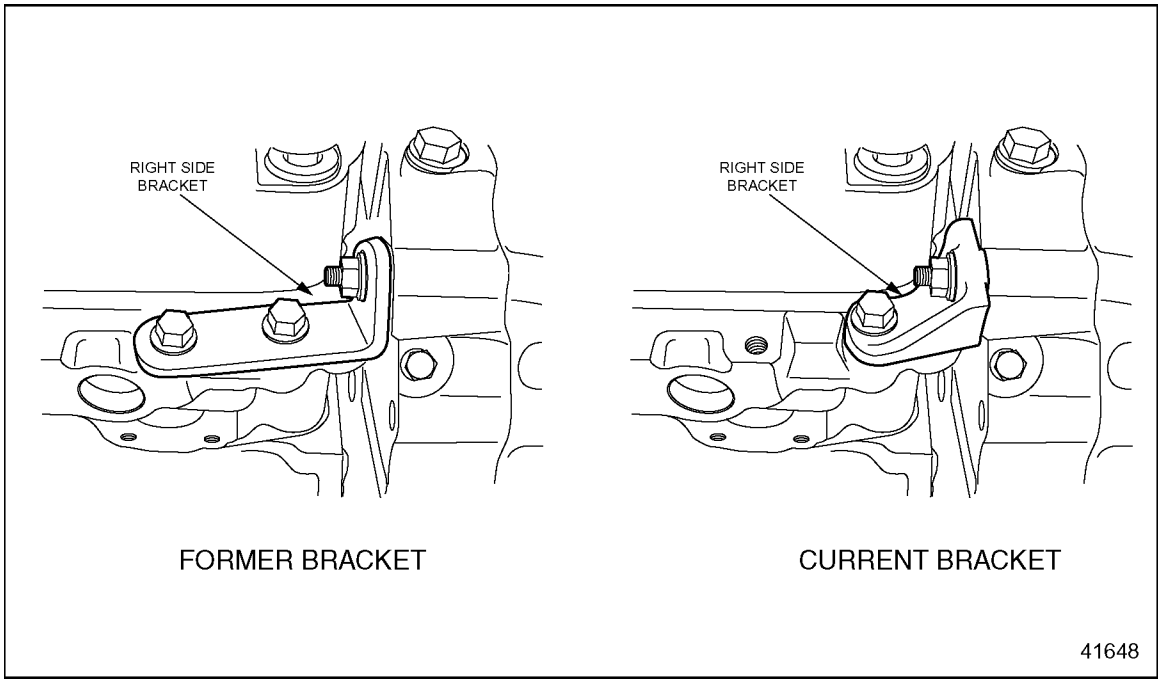

Figure 1-200 Gear Case Stiffening Bracket (Right Side)

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9. Remove the three bolts securing the left side gear case stiffing bracket. See Figure 1-201

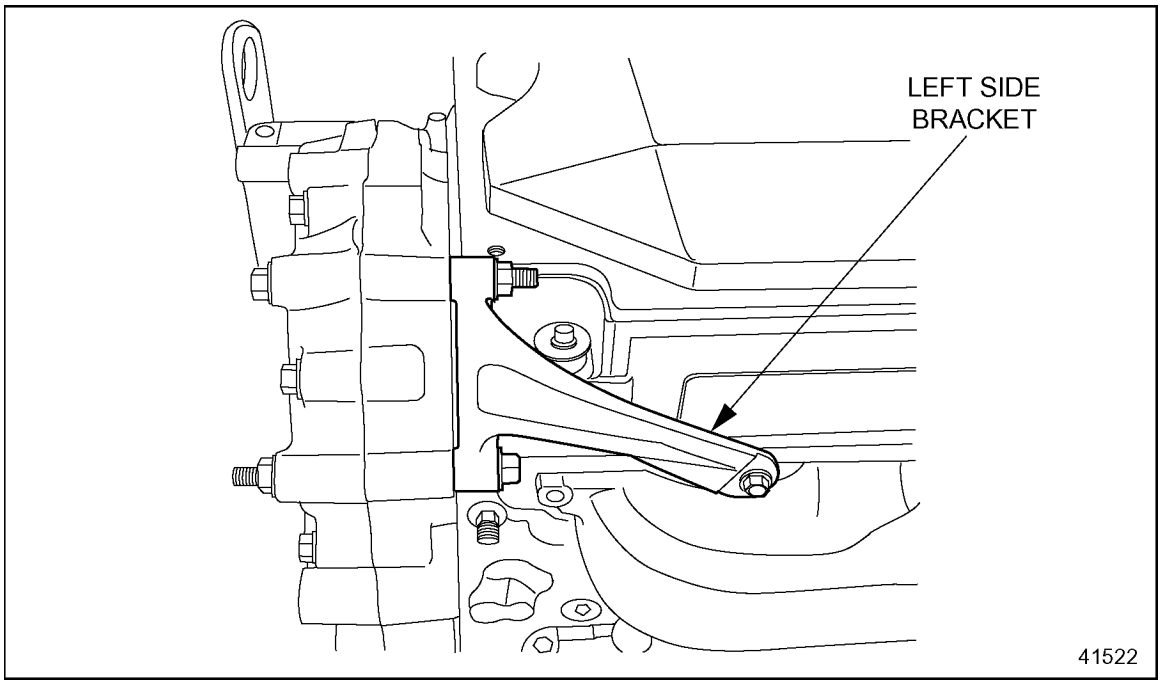

Figure 1-201 Gear Case Stiffening Bracket (Left Side)

10. Remove gear case cover. Refer to section 1.10.2, for step 1 through step 13. Supporting the gear case cover with a suitable lifting device, but don't remove it.
11. Remove the fuel pump from the fuel pump drive assembly (or air compressor). Refer to section 2.6.2 .
12. Remove the air compressor. Refer to section 10.1.5 .
13. Remove the air compressor drive assembly. Refer to section 10.3.2 .

14. Install the crankshaft protector, J 35994, to the oil seal contact area of the crankshaft. This will help to protect the crankshaft seal surface when removing the bull gear and camshaft idler gear assembly. See Figure 1-202.

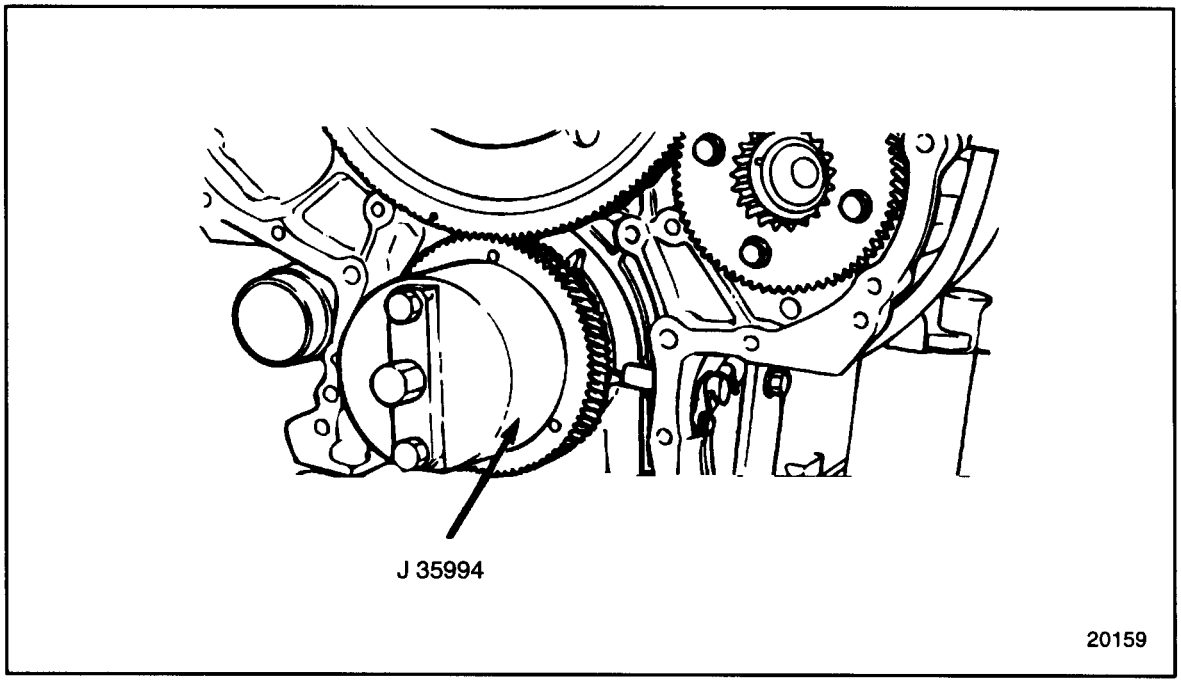

Figure 1-202 Crankshaft Protector Installation

15. Remove the bull gear and camshaft idler gear assembly from the engine. Refer to section 1.26.2.
16. Remove the adjustable idler gear assembly from the gear case. Refer to section 1.25.2.
17. Using a plastic hammer or fiber mallet, tap the rear face of the camshaft thrust plate to remove the thrust plate, camshaft drive gear hub and camshaft drive gear from the gear case.

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18. Remove the 12 bolts that secure the gear case to the engine block. See Figure 1-203

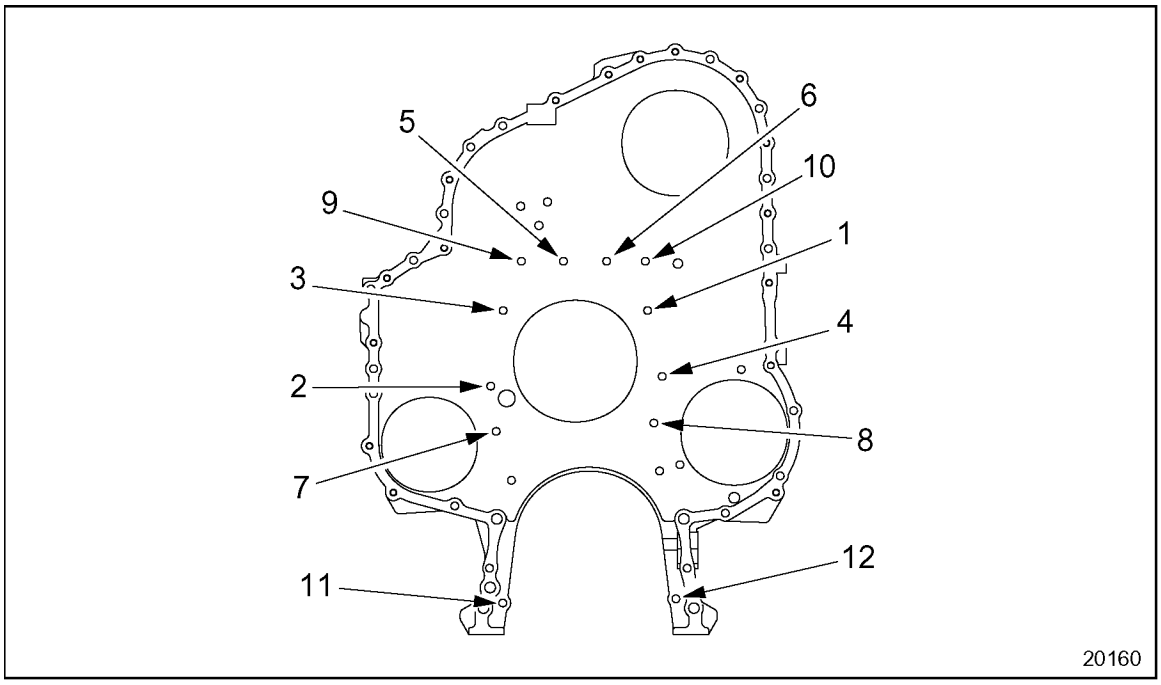

Figure 1-203 Gear Case Mounting Bolt Locations

For Series 60 2002 Engine remove bolts as follows:

19. Remove fourteen bolts that secure gear case to engine block. See Figure 1-203a

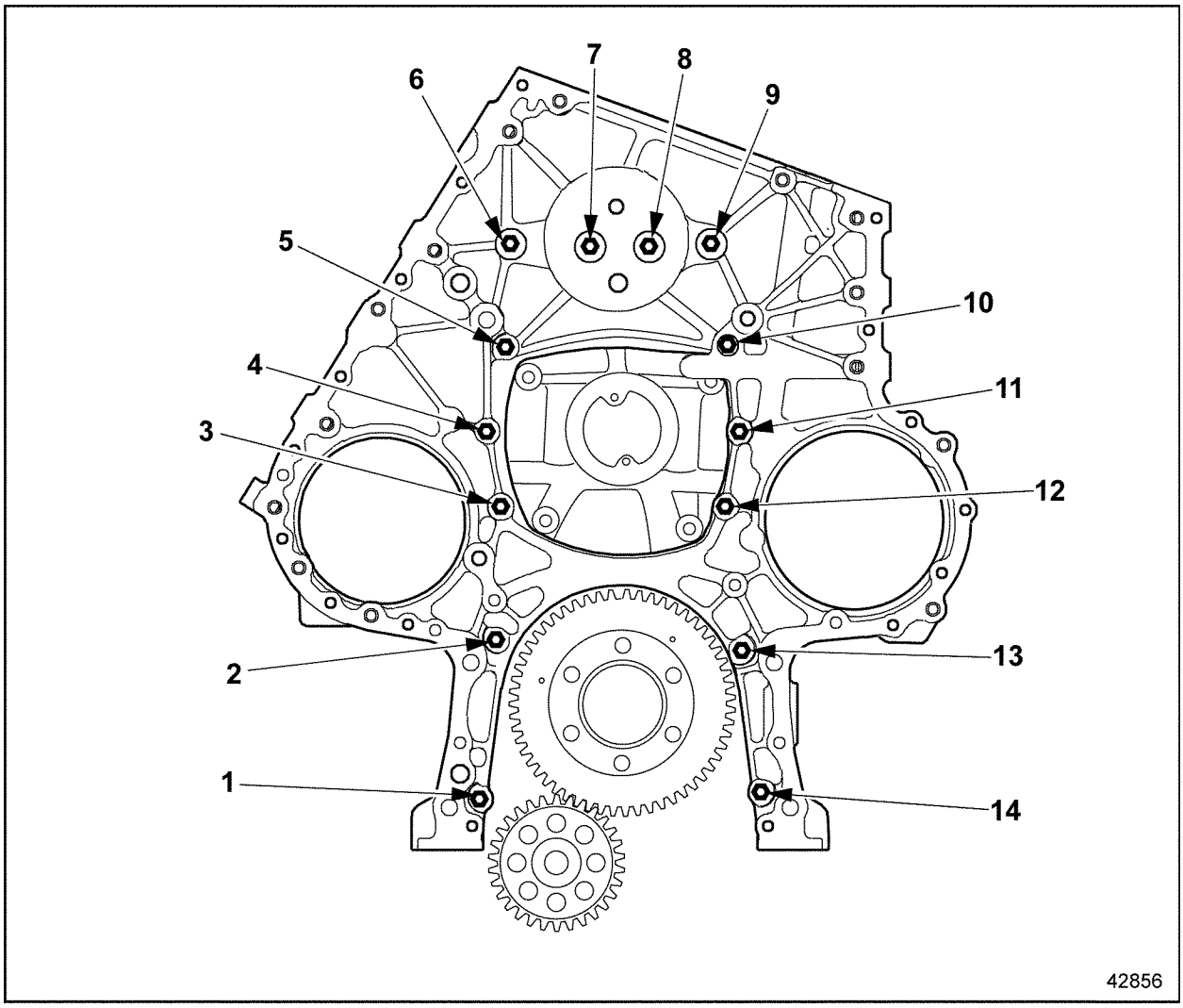

Figure 1-203a Gear Case Bolt Locations

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20. Using a leather or cloth-wrapped strap, support the gear case. See Figure 1-204. For Series 60 2002 engines see Figure 1-204a

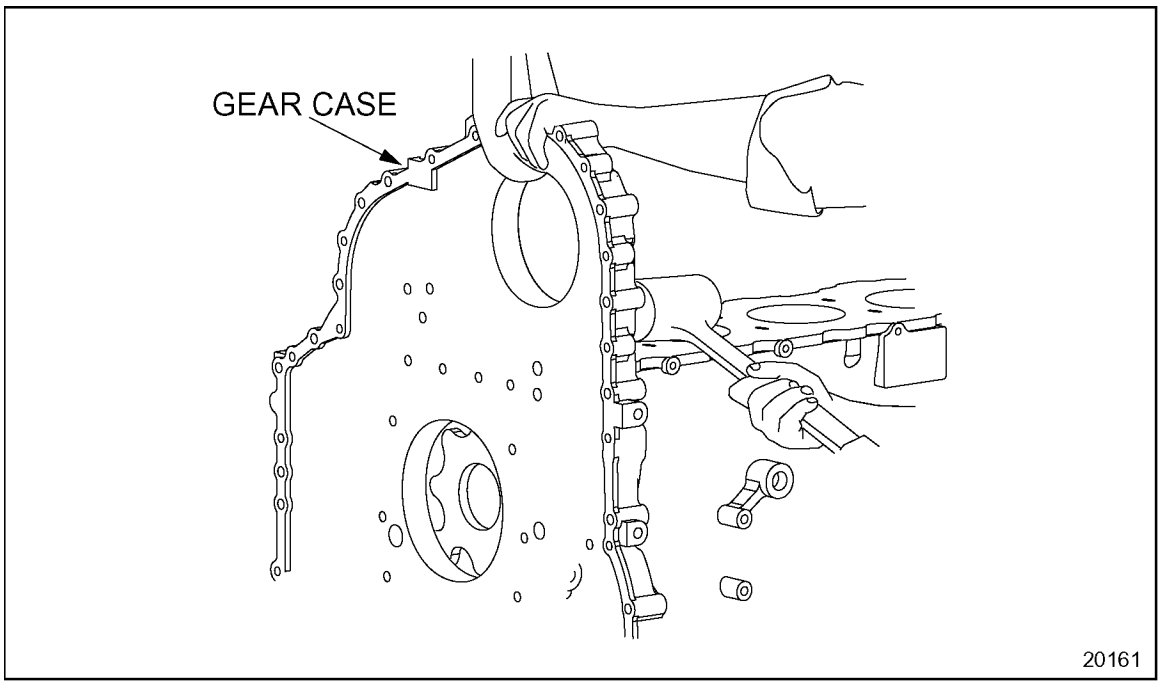

Figure 1-204 Gear Case Removal

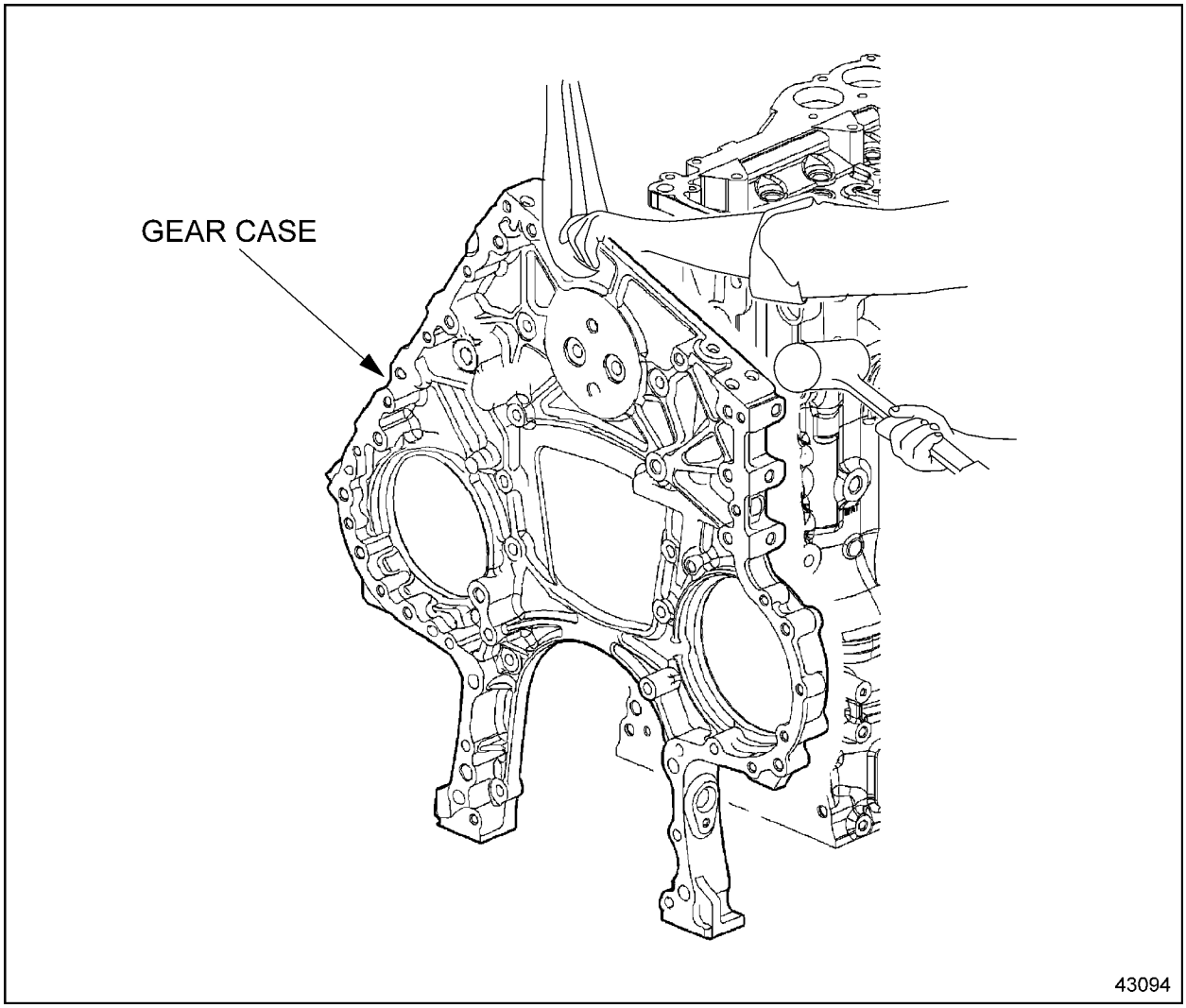

Figure 1-204a Series 60 2002 Gear Case Removal

21. Use a rubber hammer or plastic mallet to loosen the gear case from the cylinder block dowels.

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1.11.2.1 Inspection of Gear Case

Clean all of the old gasket sealer from the mating surfaces of the gear case, gear case cover, and engine block. Refer to "Gasket Eliminator® Removal," in the "General Information" section at the beginning of this manual. Clean the gasket material from the mating surfaces of any components or access covers that were removed from the gear case cover or gear case. Clean all of the parts with clean fuel oil and dry with compressed air. Remove the oil gallery plug at the edge of the gear case. See Figure 1-198.

⚠ CAUTION:

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

Use compressed air to ensure the oil gallery is completely free of blockage. If necessary, use a wire brush to clean the gear case oil gallery.

Inspect the gear case for stress cracks, breaks, or other damage. Repair or replace as necessary. Inspect the adjustable idler gear studs for signs of galling or scoring. Replace as necessary. Inspect all the individual components as outlined under the appropriate section.

1.11.3 Installation of Gear Case

Use the following instructions for gear case installation:

1. Apply a thin film of Gasket Eliminator® PT-7276 (Loctite® 518) or equivalent to the cylinder block. See Figure 1-205. Carefully smooth the bead around the block-to-gear case oil passage to avoid contamination.

NOTE:
The installation of Gasket Eliminator® to the gear case-to-block mating surfaces at the top of the block is critical. Excess gasket eliminator material can extrude into the oil passage between the block and gear case, causing early failure of components. In addition, the bull gear recess area MUST be cleaned of any and all foreign material after installation of the gear case to the engine block.

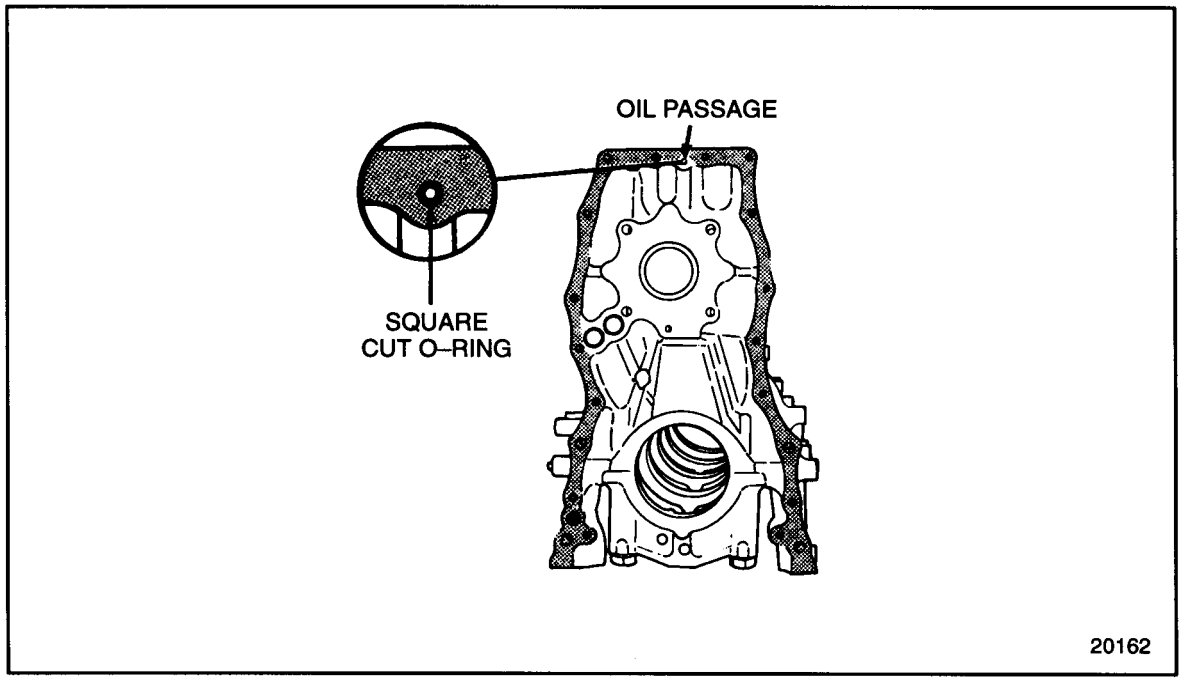

Figure 1-205 Gasket Eliminator Application

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2. Insert gear case alignment plug, J 35651, into the bull gear and camshaft idler gear hub recess in the cylinder block. See Figure 1-206.

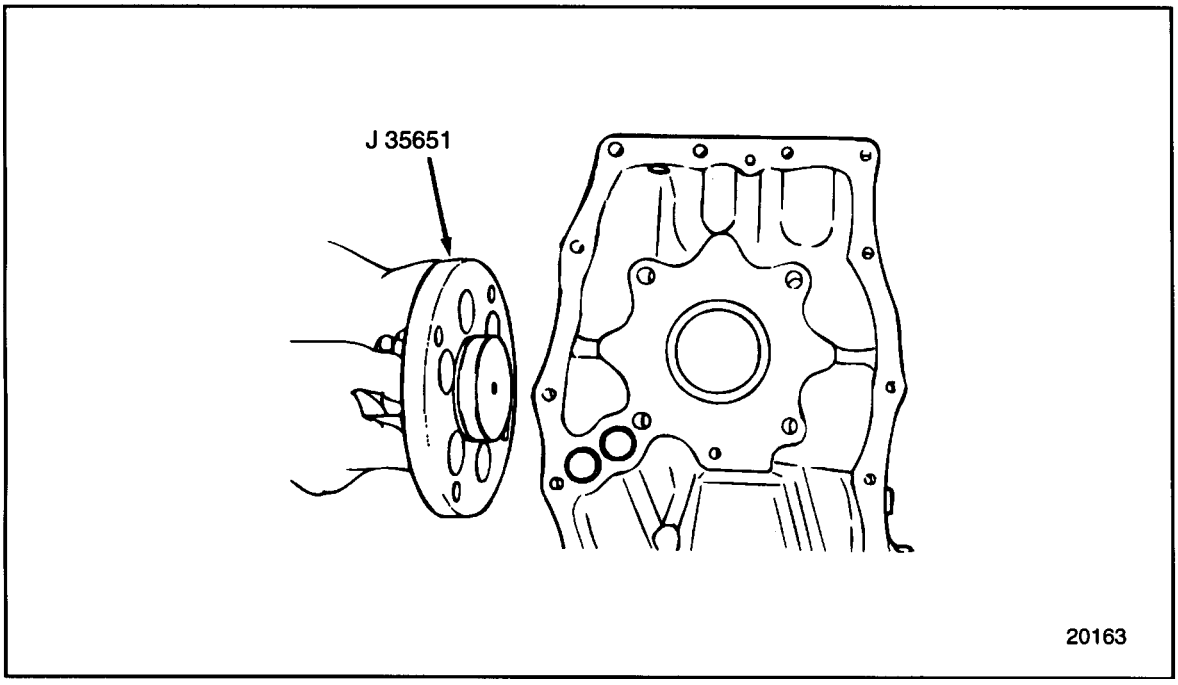

Figure 1-206 Gear Case Alignment Plug

3. Using a suitable lifting sling made of cloth or leather, position the bull gear and camshaft idler gear opening of the gear case over the gear case alignment plug. Index the hole in the gear case mating surface with the diamond dowel at the lower left corner of the cylinder block. See Figure 1-207.

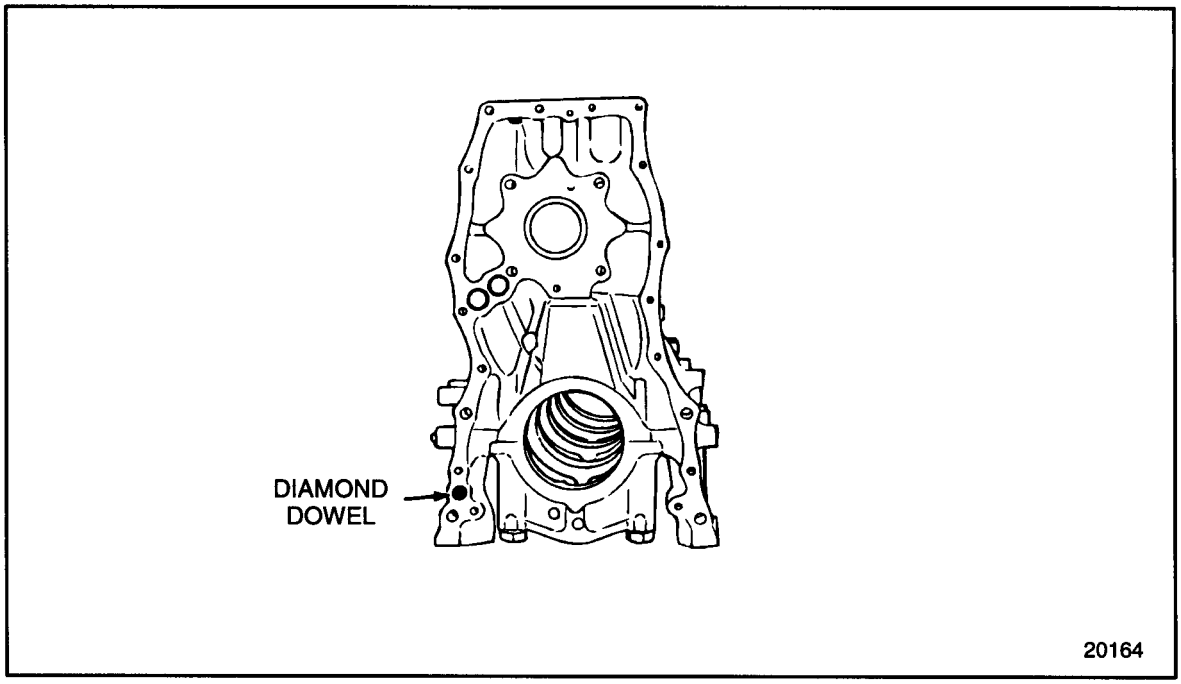

Figure 1-207 Cylinder Block Locating Diamond Dowel

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4. With the gear case alignment plug fully seated, the gear case centered on the alignment plug and the diamond dowel in the cylinder block indexed with its mating hole in the gear case, the gear case is positioned properly for bolt installation. See Figure 1-208.

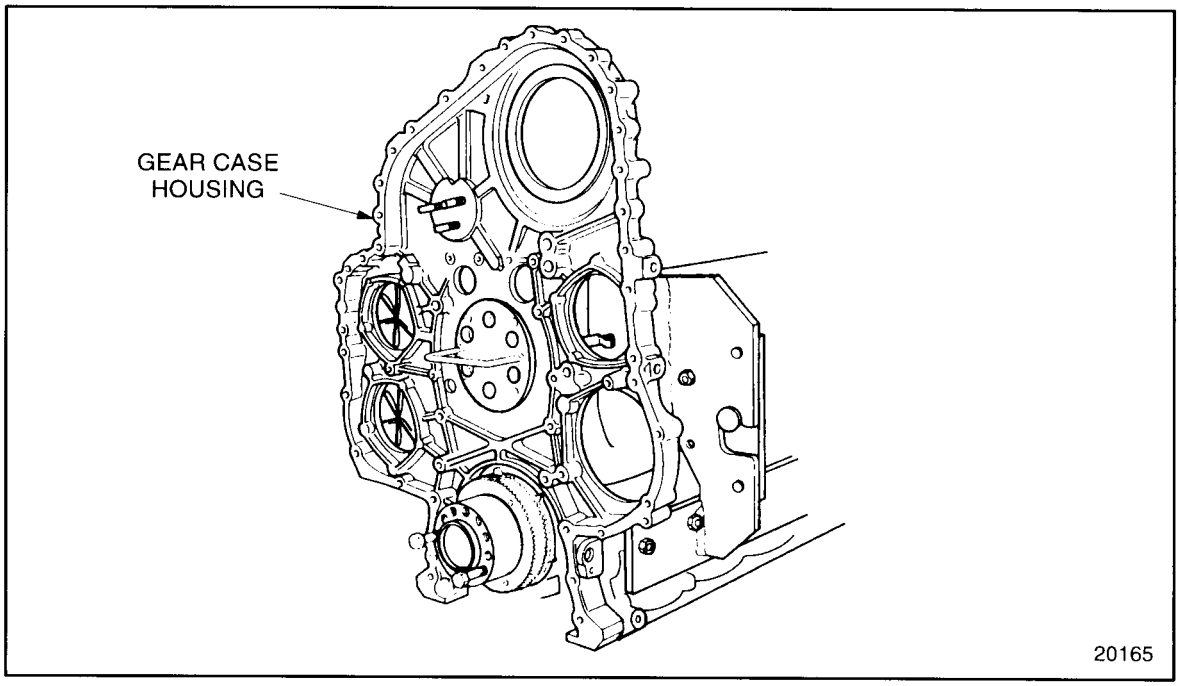

Figure 1-208 Gear Case Positioning

NOTE:
Gasket Eliminator cures with the absence of air. The time between the installation of the gear case, and torquing of the bolts that secure the gear case to the cylinder block should be kept to a minimum.

5. Install the 12 gear case-to-cylinder block retaining bolts, finger-tight.
6. Torque the gear case-to-cylinder block bolts to 58-73 N·m (43-54 lb·ft). See Figure 1-209.

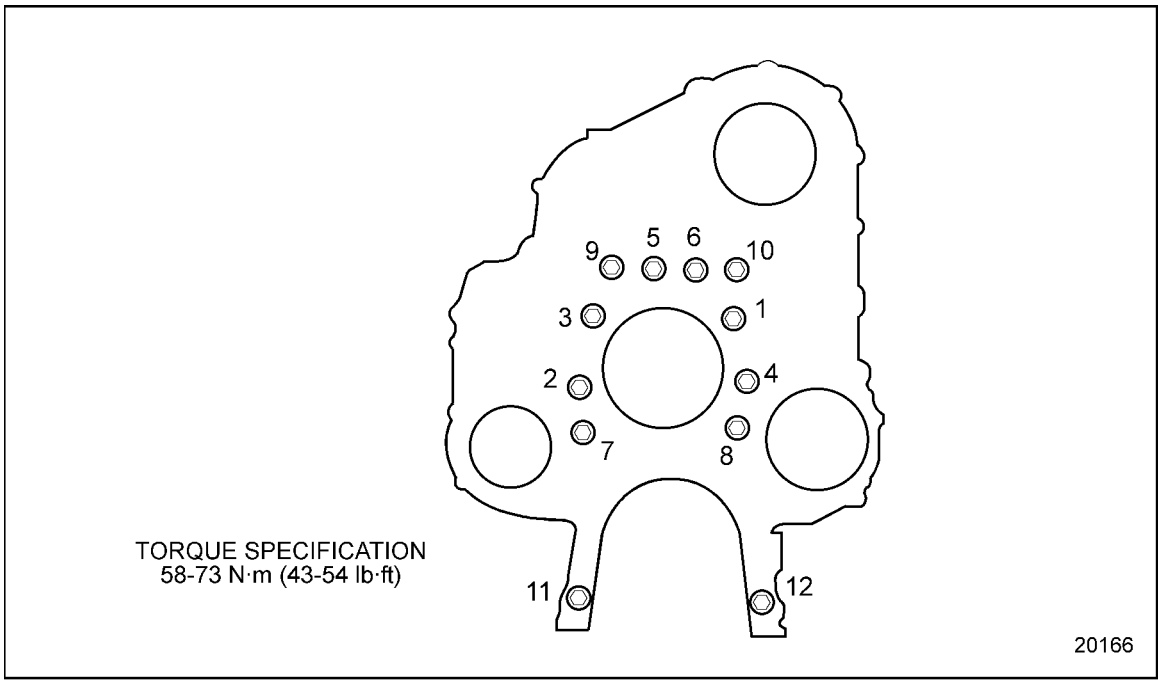

Figure 1-209 Gear Case Housing Bolt Torque Sequence

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For Series 60 2002 Engine install gear case as follows:

7. There are 14 bolts that secure the gear case to engine block. For bolt torque and torque sequence see Figure 1-209a.

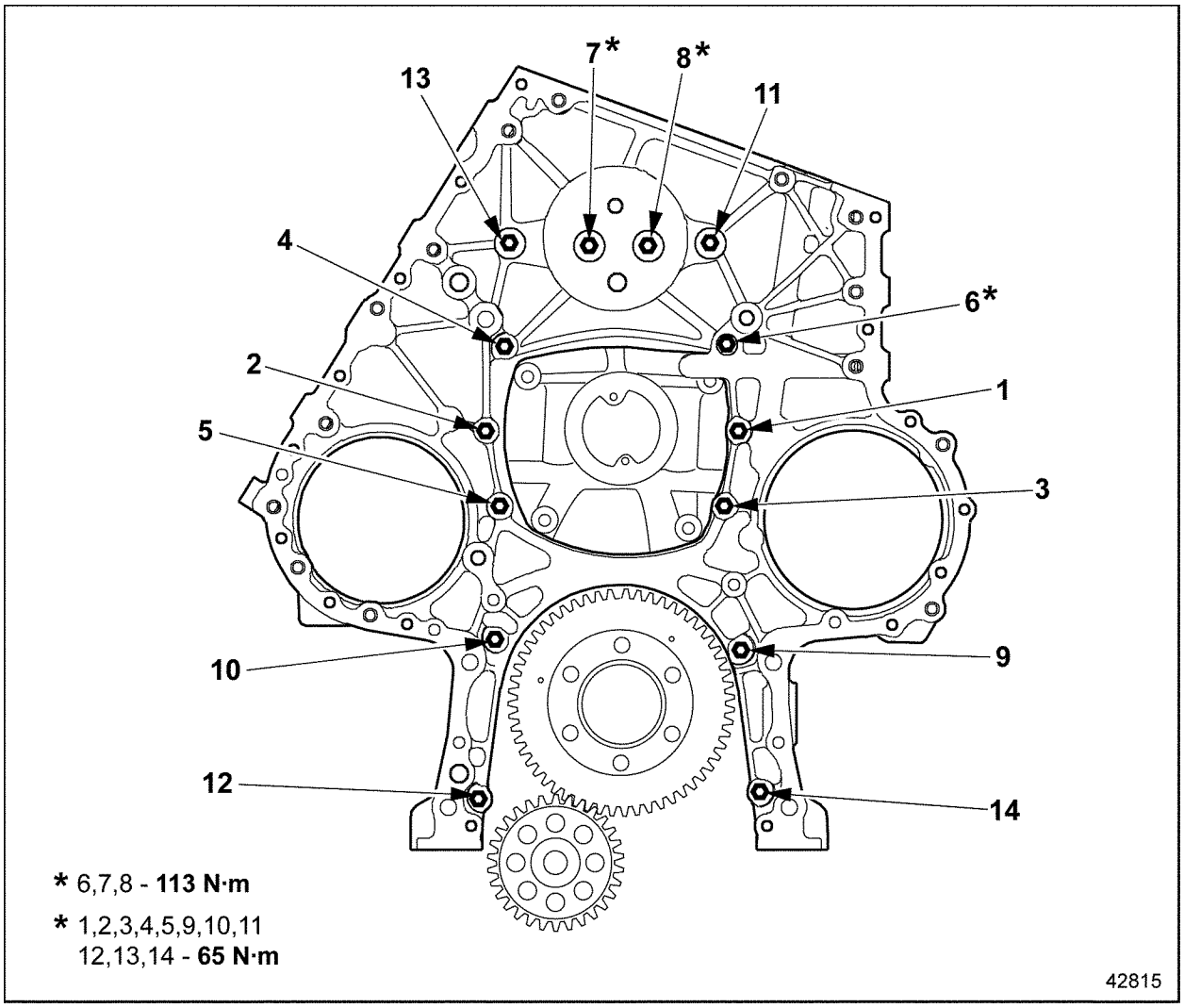

Figure 1-209a Gear Case Torque Sequence for Series 60 2002 Engine

8. Remove the gear case alignment plug from the gear case.
9. Install the air compressor. Refer to section 10.1.8.
10. Install the air compressor drive assembly. Refer to section 10.3.6 .
11. Install the fuel pump drive assembly to the gear case, if so equipped. Refer to section 2.6.5 or refer to section 2.6.6 .

12. Install the fuel pump to the fuel pump drive assembly (or air compressor). Refer to section 2.7.3 .

NOTE:
For 1991 and later model year engines, refer to section 4.2.8 or refer to section 4.3.7 and install the water pump assembly.

13. Lubricate the rubber O-ring on the camshaft thrust plate with clean engine oil. Install the camshaft thrust plate assembly, with the camshaft drive gear and hub in place to the gear case, using a plastic hammer or fiber mallet to tap the thrust plate rearward in the gear case just enough to start it in the gear case. See Figure 1-210.

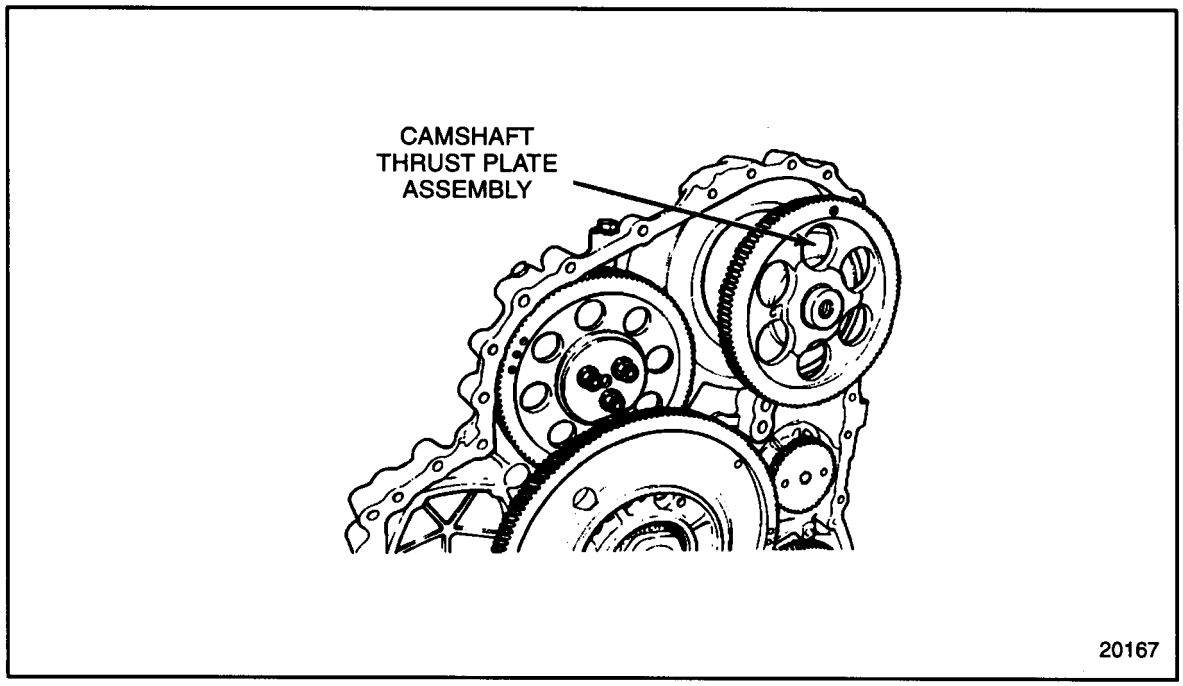

Figure 1-210 Camshaft Thrust Plate Installation

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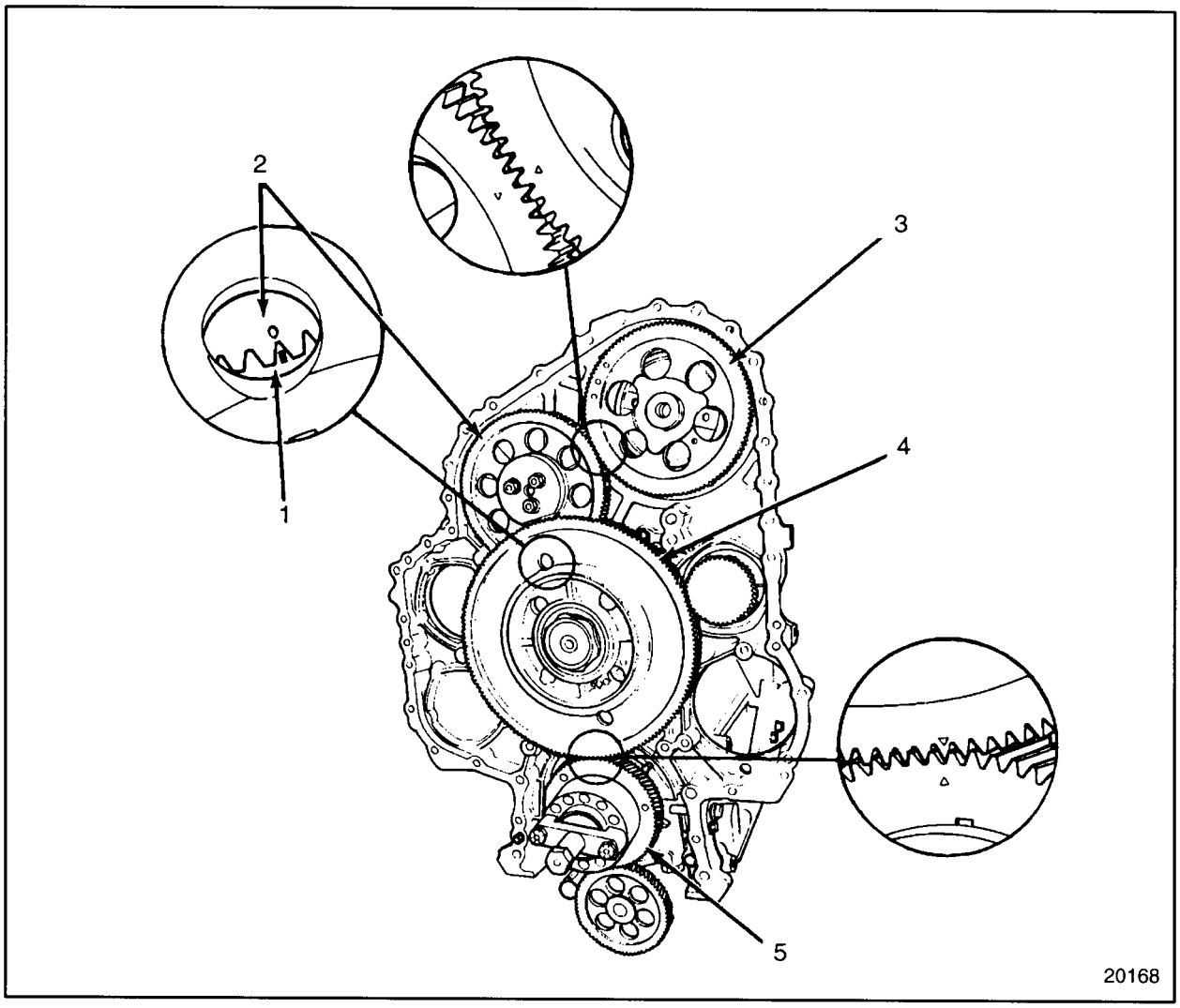
14. Install the adjustable idler gear assembly to the gear case. Refer to section 1.25.3. Align the timing marks of the adjustable idler gear and camshaft drive gear. See Figure 1-211.



1. Camshaft Idler Gear
2. Adjustable Idler Gear
3. Camshaft Drive Gear
4. Bull Gear
5. Crankshaft Timing Gear

Figure 1-211 Engine Gear Train Timing Marks

15. Inspect the bull gear and camshaft idler gear access opening in the gear case and remove any foreign material.

16. Install two bull gear guide studs, J 35785 to the cylinder block. See Figure 1-212.

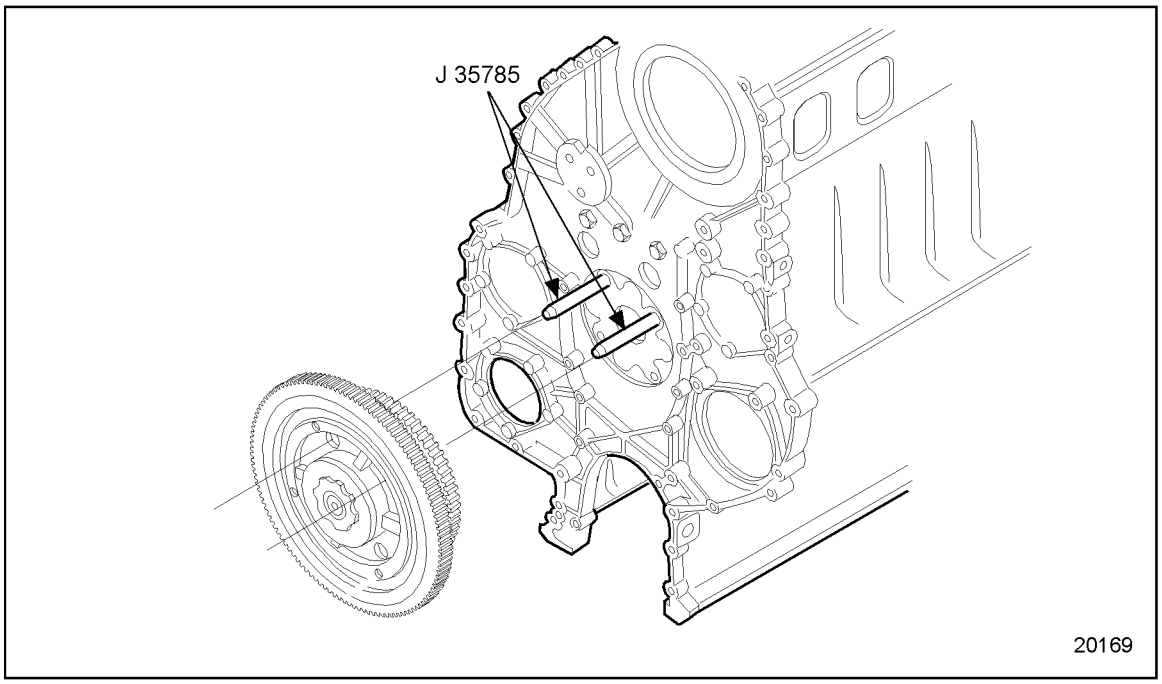


Figure 1-212 Bull Gear Guide Stud Installation

NOTICE:
Always install crankshaft protector when installing the bull gear and camshaft idler gear assembly to prevent damaging the crankshaft oil seal contact surface.

17. Install the crankshaft protector, J 35994 to the oil seal contact area of the crankshaft. This will help to protect the crankshaft seal surface when installing the bull gear and camshaft idler gear assembly.
18. Install the bull gear and camshaft idler gear assembly to the guide studs. Align the timing marks on the bull gear and the crankshaft timing gear and the camshaft idler gear and adjustable idler gear; see Figure 1-211, and slide the bull gear and camshaft idler gear assembly forward to seat it in the recess in the gear case and cylinder block.
19. Working through the lightening holes in the bull gear, install two of the bull gear assembly mounting bolts through the hub and into the cylinder block. Finger-tighten the bolts.
20. Remove the two bull gear guide studs. Install the remaining two bull gear assembly mounting bolts. Torque the bolts to 101-126 N·m (75-93 lb·ft). Tighten in a clockwise sequence.
21. Check the timing marks on the gears to ensure the gear train is properly timed. See Figure 1-211.

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22. Perform the following:

[a] For crankshaft timing gear-to-oil pump gear lash measurement. Perform step 2, refer to section 1.21.2.1.

[b] For crankshaft timing gear-to bull gear lash measurement. Perform step 3, refer to section 1.21.2.1.

[c] To install the gear case cover. Refer to section 1.10.3.

[d] Install the two bolts and nuts securing the left side gear case stiffening bracket to the gear case. Torque to 75–81 N·m (55–60) lb·ft). See Figure 1-213

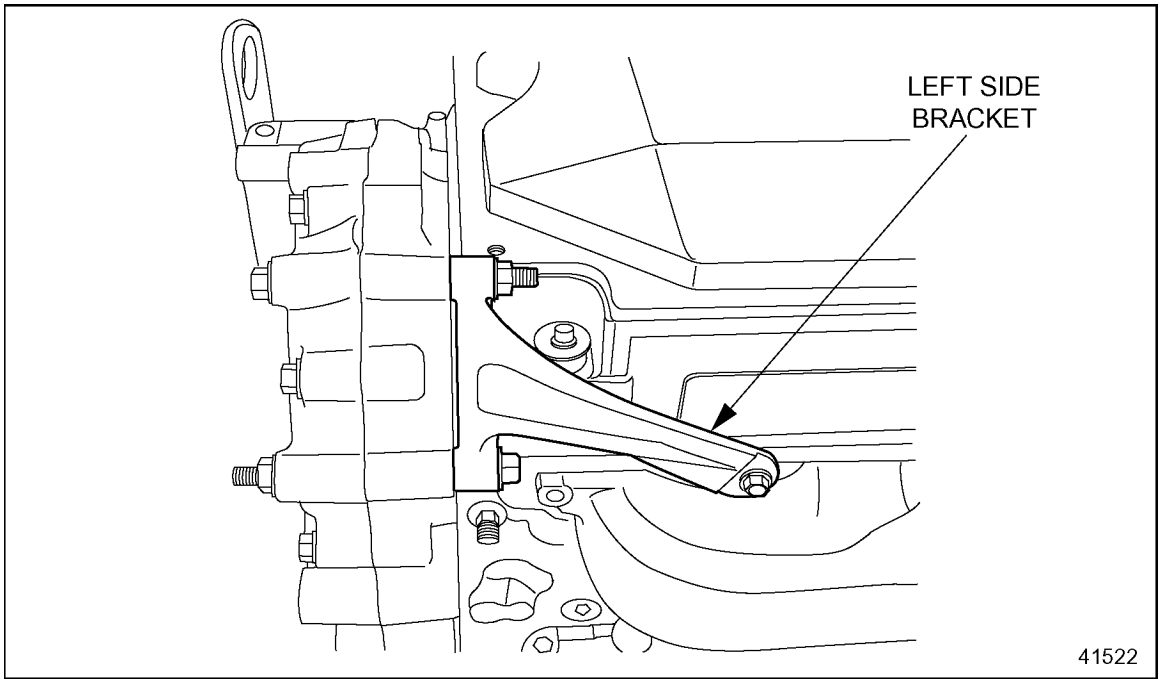

Figure 1-213 Gear Case Stiffening Bracket (Left Side)

[e] Install the bolt securing the left side gear case stiffening bracket to the cylinder head. Torque to 58–73 N·m (43–54 lb·ft). See Figure 1-213

[f] Install the bolt securing the right side gear case stiffening bracket to the gear case. Torque the former bracket bolt to 58–73 N·m (43–54 lb·ft) or torque the current gear case bracket bolt to 74–81 N·m (53–60 lb·ft). See Figure 1-214

NOTE:
Bolts attaching bracket to the gear case are torqued first, then the bolt to cylinder head is torqued next.

[g] Install the two bolts securing the former right side gear case stiffening bracket to the cylinder head or one bolt securing the current right side bracket. Torque the former

bracket bolts to 58–73 N·m (43–54 lb·ft) or torque the current gear case bracket bolt to 74–81 N·m (53–60 lb·ft). See Figure 1-214

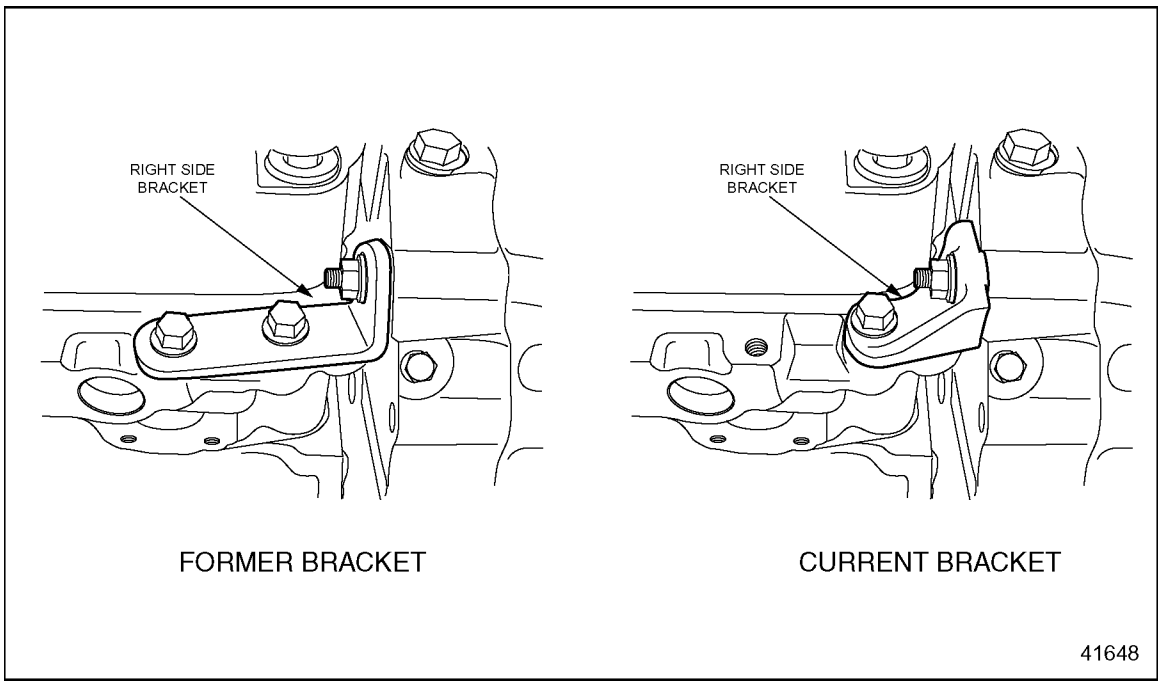

Figure 1-214 Gear Case Stiffening Bracket (Right Side)

23. Refer to section 1.23.5, "Installation of Camshaft Bearing" and perform the necessary steps.
24. For bull gear-to-accessory drive gear lash measurement, perform step 10. Refer to section 1.21.2.1.
25. Continue engine assembly.

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